PROCEEDINGS

OF THE

Nova Scotian Institute of Science

SESSION OF 1916-1917.

(Vol. XIV Part 3)

55TH ANNUAL BUSINESS MEETING.

Reading Room, N. S. Technical College, Halifax, 13th November, 1916.

THE PRESIDENT, PROF. D. FRASER HARRIS, in the chair.

Other members present: PROF. C. L. MOORE, PROF. E. MACKAY, DR. A. H. MACKAY, PROF D. S. MCINTOSH, C. B. NICKERSON, PROF. H. L. BRONSON, D. M. FERGUSON, W. L. BISHOP, PROF. A. G. NICHOLLS, W. H. PREST, and H. PIERS.

PRESIDENTIAL ADDRESS: (1) Obituary Notice; (2) The Man of Science in the Community Today.—By PROFESSOR DAVID FRASER HARRIS, M. B., C. M., M. D., D. Sc., F. R. S. E., F. R. S. C., Dalhousie University, Halifax.

(1) OBITUARY NOTICE.

Only one member of the Nova Scotian Institute of Science died during the past session. This was C. C. James, LL. D., C. M. G., who died suddenly while travelling on a tramway car, June 23rd, 1916. He joined this Institute in Dcember, 1896, as an associate member.

CHARLES CANNIFF JAMES, M. A., LL. D., F. R. S. C., C. M. G., was born in Napanee, Ont., in July, 1863, and was educated at Victoria University, Toronto. He was Professor of Chemistry at the Ontario Agricultural College, Guelph, from 1866 to 1891; in June of the latter year was appointed Deputy Minister of Agriculture and Secretary of the Bureau of Industries of Ontario; and more recently became the Dominion Commissioner of Agriculture. He was a fellow of the Royal Society of Canada, was made a C. M. G. in 1911, was president of the Ontario Historical Society, and has also occupied other prominent offices. He was well known as a lecturer and a contributor to magazines, and has written several books, and brochures on historical and literary topics, besides those on agricultural subjects. He was considered one of the best men in the public service of Ontario and possessed a thoroughly scientific knowledge of agriculture, combined with high talents of iniative and administration.

(2) THE MAN OF SCIENCE IN THE COMMUNITY TODAY.

Gentlemen:—Appalling beyond human comprehension as are the evils of this insanest of all wars, yet it cannot be denied that some measure of good is emerging distinctly from the welter. It is not too much to say that for the first time in the history of the British Empire, science is coming into her own. It is no doubt humiliating to have to confess that it was the misapplied science of our enemies which demonstrated to us how inferior was the place we had given science in our own national life. The land that produced Roger Bacon, Napier, Gilbert, Harvey, Newton, James Watt, Jenner, Faraday, Darwin, Kelvin, and Lister had to be shown by the exponents of science prostituted that science was nevertheless worth cultivating for its own sake.

Possibly nothing less terrific than this irruption of Teutonic

brutality would have shaken the British race out of its comfortable, mental inertia. But having been awakened, let us thankfully admit that our rulers are now doing something towards recognizing the all-prevading importance of science in the national life. Committees of various learned societies have been formed; the British Science Guild is taking action; the Royal College of science has recently presented a petition to Lord Crewe to have men of science adequately recognized, and the Government from early in the War has been consulting men of science on a large number of economic problems. Quite recently Sir J. J. Thompson has been elected chairman of an important committee to study the position of science in secondary schools and at the universities and its relations to trades, industries and professions which depend on applied science.

It cannot be denied that science, as science, has only very recently been allowed to have an independent existence in our national, intellectual system. The time is within the memory of some of us when the attempt to introduce laboratory teaching into the University of Oxford was met with a furious resistance; and when at length studies in practical chemistry were instituted they were alluded to as "stinks." History was repeating itself; for Leo Africanus, writing in the early part of the 16th century, thus described the chemical society of the learned Arabians at Fez: "There is a most stupid set of men who contaminate themselves with sulphur and other horrible stinks."

The attitude of Britain's premier University was in precisely the same spirit as that of the ex-priest Dupin who, on demanding the execution of Lavoisier, declared: "The republic has no need of chemists". This was in 1794, but fifty years later Oxford made it very clear that she too—and all that she stood for in English life—had no need of chemists or of any other kind of scientist. This was the

traditional mental attitude of educated Englishmen in the mid-Victorian era. The English gentleman knew no science, he did not want to know any, and honestly thought that neither did his country need to know any. We are all too apt to imagine that what we don't happen to care about is not worth other people caring about. The English gentleman certainly seemed to get on very well without science as countless ancestors had done before him; and where were there any gentlemen so perfect as those of English birth? He spoke, like one of the characters did in "Trilby", contemptuously of all foreigners as "damned". The French perhaps were his only rivals, and even in them he discerned faults, for did they not gesticulate when they spoke, and were they not wholly ignorant of sport? Without doubt, England's product par excellence was gentlemen. The public schools turned them out each year worthy of the high traditions of their forefathers. The English gentleman had his ancestral country seat in its beautiful timbered park, a haunt of ancient peace, for in all probability it was once an ivy-covered monastery; he had a rent roll so large that he never needed to soil his hands; but if he *did* want a profession for a younger son, were not the Church, the Navy, the Army, the Diplomatic Service, the Civil Service preferably of India, the Bar or lastly Politics all open to him? Everything else if not vulgar might be left to eccentric, beastly, long-haired foreigners—painting, sculpture, poetry, music. Literature as a profession was not to be thought of: of course it was respectable, for Macaulay, Lytton, and Beaconsfield had been it, and Scott was a gentleman; but really it was not "the thing". Of course there was the life of a 'Varsity Don, if by chance you were badly off and your son had brains—the life of a classical scholar was not vulgar; but the typical English gentleman didn't need University emoluments, and certainly didn't wish to assume University duties. The vast majority of University or School appoint-

ments were held by men who were already respectable for they were already clergymen. In the Army and Navy, whatever else he was, he was brave; but he left any science which those services required to those far beneath him, to those who were specially paid to bother about "beastly" technical details.

As regards the practice of Medicine, an applied science, he held exactly the same view as the ancient Roman who said that that was an occupation quite unworthy of a gentleman. But to do him justice, had this typical Englishman desired the profession of pure science, there was none for him to follow. The only professions he knew of were occupations descended from a remote antiquity—the church, fighting or the law—with all the prestige and privileges appertaining to things of such ancient lineage. I remember well, when, in the early nineties, I once filled up a form under the heading "Profession" with the word "physiologist," my father exclaiming, "But that's not a profession". He was perfectly right from his mid-Victorian point of view; it was not a profession in the sense that the Church, the Services and the Law are professions. Where were the ancient privileges, the social recognition, the pensions or fees for physiologists? Nowhere at that date, save as subjective potentialities. There was a day when it was true that the world had no need of physiologists. I was told the absolute truth when I was once informed that as far as my occupation was concerned with social recognition, I might just as well have been a hangman.

Science had not yet come into her own.

No doubt Governments have officially recognized such a science as Astronomy in the appointment of an Astronomer-Royal because of the enormous importance Astronomy has in its relations to navigation so especially important for a seafaring nation as the English have always been.

But, as we know, in course of time things changed. There was at last some science pure and applied, there was at last some exact knowledge to be known and taught; still it was not for gentlemen. It might be all very well for those who had to make engines and steamers and railways and bridges, but it was still not a profession; you dirtied your hands over it, and in particular, it was not taught at the only two Universities in England, for that godless institution (!!), University College, Gower Street, London, W. C., did not count at all.

One of the earliest national recognitions of pure science was the institution of the School of Mines in London, and later of the Royal College of Science now at South Kensington. The name of Huxley will always be associated with these institutions, as well as with drawing the attention of the British public to the existence of Science as a factor in the life of the community. He also brought to notice the dreadful inadequacy of the pay of the pure scientist. It is told in his biography how on one occasion he was asking some patron of an appointment he sought to vote for him, when this gentleman enquired, "But how much is the position worth after all?" "One hundred pounds," replied Huxley; "Good gracious," exclaimed the other, "I give more than that to my butler!" Precisely; we pay for what we most desire; we will pay for those who provide us with food and take care of our clothes—but pay scientists! No. Who are they in any case?—there is no such profession, day labourers' pay is good enough for them. But science grew for all that: "magna est veritas et prevalebit". Even gentlemen now touched the accursed thing. Did not the late Marquess of Salisbury have a private laboratory at Hatfield house; was not one of his nephews, F. M. Balfour, the Reader in Embryology at Cambridge; is not the Earl of Berkeley a physicist, and F. R. S.; is not Lord Raleigh at the present moment one of England's chief authorities

on physical science and an ex-President of the Royal Society to boot? Boyle of "Boyle's Law" was born in the purple, for he was the brother of the Earl of Cork; and was not the discoverer of Hydrogen gas, the Hon. Mr. Cavendish, a member of the noble house of that name, the Dukes of Devonshire?

Science then became at last at least respectable, even if it was not a profession. Doubtless there had always been a few respectable amateurs who cultivated pure science, for from them indeed under Kingly Patronage had the Royal Society itself actually sprung.

The instituting of degrees in Pure Science—B. Sc. and D. Sc.—by the University of London did a very great deal to foster the study of pure science in England and give it academic status. But in some nostrils at Oxford science still stinks; and it is still no profession.

When one says that the man of science is necessary to the national life, one generally thinks how science underlies the great trades and chemical manufactures, all the activities of our vastly complicated social system of railways, ocean transport, telegraphs, telephones, gunnery, aviation, and a thousand other modes of activity. But the man of science is as necessary to the national welfare in an infinitude of less conspicuous and more familiar ways.

We have all heard of scientific farming, the intelligent utilising of the resources of the soil in order to raise the largest crops of the best quality; but in very truth scientific knowledge underlies a proper understanding of so apparently simple a thing as marketing, buying the day's or the week's provisions.

The woman who knows that the nourishing value of twenty-five cents' worth of green leaves (so called salad) is not the same as that of twenty-five cents' worth of milk or eggs or beef is superior to her who has still to learn it by experience and indigestion. The light of Nature is by no means sufficient to show the purchaser of food what sort

of food will best support the body and yield it heat. There is a science of Food or Dietetics as surely as there is a science of Astronomy or Geology, and it is of much more consequence to "the man in the street".

Similarly Science underlies the practice of proper ventilation; a knowledge that the constant removal of bedroom air without a draught is necessary to health would save thousands of lives annually from being cast upon the void of tubercular infection. There is a science of Ventilation, first expounded and practised by an English church clergyman, the Rev. Stephen Hales, D. D., F. R. S., in the eighteenth century, but by no means understood today even by some most eminent architects. And does not science or exact knowledge underlie the choosing of clothes' stuffs and even the wearing of clothes? If, as Carlyle insisted, there is a philosophy of clothes, there is surely also a science of clothes. A knowledge of animal calorimetry will inform us as to the composition, weight, color, texture and much else of the clothes to be worn under varying conditions.

And so, too, science has something to say about such commonplace things as the duration of sleep proper to different ages of the child and of the youth; how the lack of it leads to inefficiency at school, how work before breakfast for school children is a physiological immorality. Science has something to say about the arrangment of hours of work and play in the school time-table, how fatigue of body and of mind can be recognized, prevented or cured, how the congenitally deficient child may be distinguished from the backward or merely lazy one. Science explains the significance of night-terrors, of growing pains, of headaches, of uncontrollable sleepiness in children; it has views on the games suitable for boys and girls at different ages; it supervises the gymnasium, the swimming-bath and the playing-field. The man of applied science, the physician, recognizes dilated heart, cardiac palpitation, and many of the significant

things arising from too much athletics which were overlooked by parents and teachers in the good old pre-scientific times.

Science in daily life, in so-called common life, is simply intelligent living—*the* great need of the community of today. The man of science has much to say about house-construction, house heating, drainage, sewerage and other technical problems deeply affecting the health of our cities on which "the light of Nature" throws very little light indeed.

I would go so far as to say that science has become the most important factor in the life of today. "But," some one may ask, "shall we not always need lawyers?" To which I would reply, that as long as human nature remains as it is, we shall always *have* lawyers, but we really *need* the man of science to guide us in crossing the unlit, uncharted desert of this world.

If any one is disposed to belittle science, I have an infallible cure; make him go through a day without the aid of anything that involved science in its discovery or making. Let such a person get up and try to light the fire; you cannot allow him matches, for phosphorus was discovered by men of science and is utilized by them in many ways. You could not allow him to wear clothes, for their fabrics were woven by a machine which was the result of scientific ingenuity applied to this very problem of weaving fibres into fabrics.

But we are not done with science in common life; it underlies the intelligent rearing of children, and prevents our giving them gastro-intestinal catarrh by allowing them a little of "whatever is going" which may range from gin to Welsh rarebit. The light of Nature gives a young mother instruction only up to a certain point as regards infant feeding. The man of science has developed Pediatrics.

Dust and flies have, in these recent days, come under the light of science, and this has shown them to be grave menaces to the well-being of the human race. A large number of serious, infectious, epidemic diseases are now

known to be insect-borne. Some of these are infantile gastro-enteritis, malaria, yellow-fever, typhus fever, typhoid fever, plague and the ophthalmia of hot countries.

Science has taught us what infection means, that it is not a vague, indefinable "principle", but a real, living, objective existence, ultra-visible, yet withal capable of being apprehended and sealed down under a microscope, of being recognized as specific, and lastly, happily able to be destroyed by sunlight, heat and certain chemical substances. It is sometimes said that science has added new terrors to our life; it has only done so when misused by the Hounds of Hell; it has rid our communities of those frightful scourges of the Middle Ages, Cholera, the Black Death and the Sweating Sickness, awful in the toll they took of human life, more awful still in their mysteriousness, for they came no man knew whence, and went, no man knew whither. But in the name of precise knowledge, science has arrested these grim spectres, their terrifying masks have been torn from them, and they have been revealed as the lowliest of the fungi, allies of the mushrooms and the moulds which prefer to live in darkness. The pestilence has been dragged into the light of noon-day, disarmed and conquered.

Science has added no terror to life; but it has rid us of the terror by night, of the pestilence that walketh in darkness. The night of ignorance is fast coming to an end, the bright dawn of the ampler day of exact knowledge is already bursting on the world.

And the man of science thinks of the future of the community; he sees it self-evident that one hundred sick and weakly children are not likely to grow up to be one hundred robust adults. He reflects that we take the greatest trouble to produce good strains of beef-cattle and milk-cows and dray-horses, prize cats, bulldogs, and canaries. We breed selectively with an end in view for the lower creation; but mankind must be left for evermore to breed by the light

of Nature: to suggest anything else is by some regarded as a eugenetical immorality. Still it is something to have got the length of admitting that there is a problem here at all.

Science is of the very warp and woof of the web of human existence; ought we not to reckon with it officially, as it is called? Has not the time come to *admit* that Science is as important as it really has become; for the existence of something and the official admission that it exists are two different things? Why should not science be taken under the care of a cabinet minister? It is no longer vulgar, it is no longer beneath the attention of the aristocratic intellect; it is of preponderating usefulness to the nation, and it is malevolent only when divorced from common-sense and common morality by the insane, megalomaniacal obsessions of self-hypnotized Prussians. It is within a very little of being even a profession! Why not recognize the pursuit of something which is almost a respectable profession, why not have the official interests and the economic aspects of science presided over by some one who knows something about them? There is much latent vulgarity in the public mind, and a great deal of snobbishness is endemic there.

Few people recognize worth at home or excellence in homespun; the familiar cannot be great, the prophet hath no honor in his own country. You must have things magnified out of their natural proportions, removed a little from the every day setting, to be appreciated by the public. To be quite specific; the man of science must have titles, orders, decorations before he is appreciated by the blind public. This is due to a weakness inherent in human nature. Prof. Soddy, F. R. S., writing in the "Glasgow Herald" about the beginning of August, 1916, said, Science must no longer be the "Cinderella". "There is a lamentable lack of intelligent interest in the sphere of Science as an essential factor in the education of the nation, as an indispensible instrument of its civilized progress. The unfortunate attitude

of the governing classes towards Science is largely the result of the monastic traditions of the great public schools and universities in which most of our leading politicians have been trained. We seek at this supreme crisis of our national history a man of clear vision and firm purpose who, taking all branches of knowledge for his province, will assign to each its true place and function in the education and training of all classes of the people. Such a man and such a purpose have yet to be achieved."

Science must no longer be subjected to anything approaching social ostracism. The man of science is just as entitled to "your excellency" as any diplomat, living or dead.

There has been a great deal of writing during the late summer on Science versus Latin and Greek; Science in the public schools and in the Civil Service, and on Science and Politics.

Prof. H. E. Armstrong says, "war has become a branch of Applied Chemistry, hence Germany's superiority." He goes on to say that Britain is governed primarily by and from Oxford. "If the horrors of the War do not cause Britain to reform, we shall be forced to confess that our chemical industries will silently fade away. Some years ago the necessity of reforming Oxford was generally recognized by those in the University and by outsiders. The resident staff advised the abolition of compulsory Greek, but the M. A.'s—the country clergy—arose and voted for the "status quo". Here we have Science versus class-inertia.

Professor Armstrong continues: "France, in 1871, admitted that she had been defeated by the Prussian schoolmaster." A writer in "Nature" wrote lately—"Our political leaders and administrators of state departments are trained in these classical schools where vested interests preserve the prime places for ancient learning. Science is discouraged for students who hope to obtain University scholarships or appointments in the highest rank of the civil serv

We need to make science the keynote of our public service and University system as Humboldt did early in the nineteenth century when Prussia was as yet under the heel of Napoleon. The peremptory necessity of better scientific organisation is apparent; it is not now only a question of our prosperity but of our existence.

The scientific mind and temper cannot flourish in an atmosphere of political trickery, nepotism and plunder such as we have. True science and politics are incompatible. They cannot exist together, any more than the eagle and the squid."

Science, in short, must have a Department, a Government office, before the public will fully accord it its place of honor. We may regret that this sort of thing has to be, but our regret will not change public opinion; and it appears to be part of the British Constitution that nothing can be done or should be done without a very large body of public opinion behind it. But the official recognition of science cannot wait until the public has seen fit to render science the homage it deserves. To begin at the top, let there be a Minister of Science and a Ministry of Science with just as much prestige accorded it as the War Office, the Foreign Office or the Home Office. The duties of the Minister of Science would be primarily to foster science in every way possible, to foster its interests, to administer its affairs somewhat after the manner in which the Board of Trade looks after trade, the department of Agriculture and Fisheries, agriculture and fisheries.

By friendly and intelligent co-operation with the Univversities, Technical Colleges and the leaders amongst the manufacturers, the relations of science to the state could be adequately safeguarded; scientific men would be known, encouraged, subsidized, promoted, rewarded, and pensioned,

For why should state recognition, encouragement, promotion, and rewarding be reserved for sailors, soldiers,

diplomatists and lawyers? Why should it be so entirely correct to be paid for legal opinion, and such "bad form" to be remunerated for scientific advice? Because, you may rely, the Law is an ancient, respectable profession, and science is so modern that it is not a profession at all. But this mediaeval state of affairs cannot go on indefinitely; it was all very well for the day when there was no science to foster, and men quarrelled so much that lawyers were kept very busy, but now "nous avons changé tous cela"—or at least the earlier part of it. One need not here and now draw up an exhaustive list of the duties of the Minister of Science, but might merely remark that much that falls under the supervision of the Home Office could be transferred to the Department of Science. Had there been such a department, Edward Jenner, for instance, would not have had to struggle against every kind of obstacle and misrepresentation for as long a time as he did, or have had to wait as long as he had for the official recognition of what he had done for suffering humanity. Not from his own private house but from a Government department would the vaccine have gone forth to eager Europe. He truly called himself "The vaccine clerk of the whole world."

The first concern of the Science Office would be the place of science in the schools of the Empire. And here we come up againts the still burning question of the rival claims of Science and the Classics. Of course it ought to be perfectly possible to instruct boys in as much of Greek and Latin as would make them know the origin of the words in English derived from those languages, without necessarily making the boys read entire Greek and Latin authors in the original. The practice in the past of educating boys as though they were all going to be teachers of the classics is analogous to the teaching of Physiology to medical students as though they were allgoing to be professional physiologists. A very small minority of boys need to be able to write Latin

prose, far less verse, or even read Latin authors. Less than that is enough to enable them to know the derivation of words of classical origin, to explain some allusions to classical mythology, to pronounce the final "e" in Magdalene, Penelope, and Irene; and be able to write English with lucidity and without redundancy. Before this linguistic and literary instruction is ended, instruction in Natural Science should have begun, and should be continued long after the former is stopped We need not continue to teach boys Greek and Latin as in the days when there was little else to teach them; for in the meantime, such vast quantities of useful and essential facts have been brought to light. that we grudge all the time not devoted to the assimilating of them. It is usually supposed that because a boy knows some science, he will know no classics; and vice versa. I have never been able to see the necessity for this. Surely he can study some Science and yet know enough about Latin and Greek to enable him to understand what his scientific terms mean. But to expect any boy to attack no science until he has been made a classical scholar is ridiculous. The old method was virtually to set out to make everybody a classical scholar, and to end by making possibly one per cent. such. The other ninety-and-nine non-classically-minded persons, were made Latin-haters for the rest of their lives. The new method should be to teach all boys science, and let the one per cent. become classical experts if they desire it.

Outside the Arts Faculties of the Universities, there is no "market" for classical scholars; but there is a vehement and growing demand for persons who know something of all the sciences and everything about one of them.

Owing to our national physiological momentum, the teaching of boys has been continued on the same lines as those laid down by the educationists of the Revival of Learning in the Fifteenth Century. What Erasmus, Linacre and

Dean Collet planned was admirable for the day when America and printing had only just been discovered, but is possibly not so well adapted to the country which lights its cities by electric energy, speaks to America without wires, flies in high heaven like the eagle and descends to the abyss like a sea monster.

The Science Office will see to it that science receives official recognition in all entrance examinations whatsoever, and that it is not handicapped by receiving fewer marks than the classics or any other subject. Science must have her place in the curriculum not on suffrance or by-your-leave, but by right, and in virtue of its inherent dignity and usefulness. Science cannot any longer be the under-fed maid-of-all-work; Science is the Queen herself coming into her kingdom. Science is no longer to be merely permitted, tolerated, apologized for; she must preside at the Council Board because she already rules the lives of the people.

But it is not only the dead languages which take the place of the teaching of science in the schools. History, as often taught, is far too much the record of wars and of the immoralities of Royal Families. The struggle for freedom of thought is quite as important as that for political liberty. The History of the emancipation of a community from intellectual darkness is their real history. What do most people know of the history of Poland?—about what could be put on a visiting card; and yet they ought to know that Copernicus was a Pole, and a Doctor of Medicine, and that the title of his great book is "Revolutionibus orbium celestium", and the date 1543. The date 1543 is quite as important as 1314 or even 1066. In many cases the battles of history were not battles for liberty, but the outcome of childish quarrels between persons suffering from an inflated idea of their own importance.

The academic precedence of the Faculties, in which Theology, Arts, and Law come before Medicine and Science,

may still be tolerated at the old Universities as an interesting and significant relic of earlier times; but in all modern Universities, (as in the University of Birmingham from its foundation), Science is the Premier Faculty and takes the first place. The world advances not because of Church History or Homer or Virgil, but because of James Watt and Stephenson and Dalton, and Faraday and Harvey and Jenner and Darwin and Kelvin and Lister. Better fifty days of Faraday than a cycle of Aristotle.

This problem of the place of Science in pre-University education had better be settled once for all, because the present unsatisfactory state of matters is compromising our national efficiency. The modern community thinks that it is time to have its sons taught along lines other than those laid down by the Humanists of the end of the 15th century. It is rather ridiculous for boys to know something about Romulus and Remus, and a certain Balbus and his heaven-entreating, stained-glass attitudes, and about a few other persons who may or may not have existed before the Birth of Christ, and yet nothing whatever about the past, present or future of the world they live in or their own bodies and their mental and physical health. Anachronism of anachronisms, all is anachronism, saith the modern preacher.

It is Germany that has shown us national efficiency through science. But it is quite a mistake to suppose that those Germans who are so well trained in science are not also educated in the classics. Indeed it has recently been suggested in the British Parliament that the exhibition of German national immorality was due to their following Pagan instead of Christian lines of conduct. Personally, I think this is only part of the explanation; no Pagan writer with whom we are acquainted would have sanctioned the descent to those infra-human depths of cruelty which the Germans

have reached. The fact is that most of us Britons acquire the knowledge of any foreign language—dead or living—only with the greatest difficulty. It is not that the life of the ancient Greeks and Romans does not interest us, but since the way to it lies through the drudgery of acquiring a foreign grammar and vocabulary, we shrink from the distasteful task. The British difficulty in learning languages is in marked contrast with the Russian ease in this matter.

Closely allied to the subject of official recognition of men of science is that of the advisability of organizing the medical profession into a Department of Public Health, a Government Department with its medical officers, state-paid and state-pensioned. In other words, although preventive Medicine is state-controlled, curative Medicine is still the same old, unorganized, happy-go-lucky competition it ever was. Some thinkers assert that the time has now come for the appliced sience of curative medicine to be taken over by the state and organized into a system. Both departments—preventive medicine and curative medicine — would be under the Department of the Minister of Science. Naturally there would be but one portal of entrance with one uniform standard of entrance examniation into the Departments of Curative State Medicine and of Preventive State Medicine. The one uniform standard of entrance would remove a great many existing anomalies. The doctor would then be to the whole public what the club doctor is to a section of it. He would have to attend to the care of cases exactly like the M. O. H. attends to the prevention of cases. He would be a state official, salaried and pensioned as such. It is an anomaly if your child has scarlet fever that, while one aspect of the case can properly be taken in hand by an official only of the one aspect of medical science, the other aspect of the case has to be left to private medical enterprise. I should be able to summon a state-paid physician for a case of broken leg, pneumonia, or of insanity, just as I do one

for a case of measles or diphtheria. This would, of course, lead to the whole problem of medical treatment being solved by being state-controlled.

The great Hospitals, with their vast, beneficent out-patient departments, would become state institutions such as prisons, penitentiaries and asylums are already. There is no valid, other than a historical, reason why the scientific cure of disease should not be a state service as much as the scientific prevention of disease. The Indian Medical Service affords us an example of a state managed, medical service; it shows us how such an organization might be so vastly extended as to become imperial. Promotions, disability pensions, retirement pensions, etc. could be arranged for as in the civil service. The state would, therefore, also logically take up the problem of research in medicine, and directing it, co-ordinate the isolated efforts made in it in the manner most beneficial for the public weal. In the United States private enterprise has endowed medical research in a truly magnificent manner. Private endowments could still be given for medical research within the British Empire, but it would be well if the direction of medical research were made a responsibility of the State. Much of it is even now, as, for instance, the splendid work on plague done in India and the work on cancer in London. The medical researcher is a medical man no less than the general practitioner, he is only more specialized. He should be equally a servant of the state.

Let us now take the concrete case of the prospective student of Medicine, a youth of 16 or 17, to whom I have to teach Physiology. I want him to know something of the classics as well as something of science, and I should like him very much to know something of chemistry, physics and biology before I begin to explain to him the functions of the organs and systems of the human body. I particularly wish that he should know, for instance, the meaning

of the terms "vascular" as applied to the circulatory system, "neural" as applied to the nervous, and "digestive" as applied to the alimentary. I don't want to be asked at the end of a lecture what I meant by the expression, "the classical experiment". I should like my students to know already the meaning of such terms as blastoderm, somatopleure, placenta, hermaphrodite, metabolism, homogeneous and homodromous before they enter upon the study of Physiology at all. It is not a classical education that we object to, but an education that is practically exclusively classical, and often indeed does not impart the very information which is afterwards most needed. In fact, just as there should be chemistry for medical students, and physics for medical students, so there should be Greek and Latin for medical students. And if it be objected that this would not produce any measure of true culture, one would be tempted to ask whether the present system of preliminary education is producing a particularly cultured type of student; a visit to the theatre on "Students' Night" would hardly foster that impression.

A very useful alteration might be made in the teaching of mathematics to boys intended for the medical profession or studying for degrees in the biological sciences. A good deal of Euclidian Geometry might be cut out, and some instruction in the use of the differential calculus substituted. The use of logarithms ought in any case to be taught to all. But we who teach such a science as Physiology hope that the day is fast approaching when such instruction in the sciences introductory to Medicine will be given at school as will enable the student on entering the University to profit at once by teaching of University standard. This would reduce considerably the number of scientific subjects in the First Year of Medicine, and so lessen the load carried in that admittedly trying year.

Why, then, is a knowledge of science so useful to the

modern community? Apart altogether from the way in which science makes for technical efficiency, it is a means second to none in the training of the intellectual powers. In the first place it trains us in accuracy of observation, in reliability of drawing conclusions, in habits of precise thinking generally; and these are not small things.

Accuracy of observation! Some of us have not the faculty of observation at all. When we have observed, then comes the drawing of conclusions, the educing of laws from our data: this is none other than the age long quest for the causes of certain effects. Each science that is differentiated out of the mass of accumulated facts is one more specific example of the successful pursuit of the causes of phenomena. Is not each fresh case I have to see, one fresh problem in the applied sciences of medicine or surgery, an exercise in the connecting of certain signs with certain underlying causes or antecedents? To do this unerringly is not at all easy. Some say, "Oh, he is a good enough medical man, but he is no surgeon," as though anybody could be a physician. The proper relating of seen symptom with unseen condition is the problem of problems in medical diagnosis, and it requires the highest development of our powers of observation and of interpreting correctly the meaning of the data collected. The whole training of the medical student is towards this end; and in practical medicine you find as great a field for the exercise of scientific analysis and synthesis as in any of the other sciences. One has constantly to disentangle causes from causal conditions; causes from contributing circumstances, positive from negative factors, facts from opinions, and so on.

I am quite aware that there is a school of thought which objects to any one thing being called a cause; but this would be very troublesome if applied to practical medicine. One of the earliest things the student has to learn is to distinguish a fact from an inference about a fact, a phenomenon from

some one's opinion about it or explanation of it. This is much more difficult than it seems. How often are beliefs and views taken for facts!

Science teaches us to sift, discriminate, weigh, relate and assess. It trains us to investigate without personal or racial bias. One of the most monstrous assertions of the Germans is that all true science has been, is, and will be German.

Science is antagonistic to all mental laziness and all mental haziness. It is opposed to all tradition which cannot give a justification for its existence. Superstition flies before the light of science. Science impresses us with the dignity of facts; with the majesty of the inexorableness of law, the inevitableness of the bond between cause and effect, and the omnipresence of the principle of continuity. It does not allow us to accept the opinions of any man however exalted unless he can demonstrate them to us as derived from observed data by processes of reasoning similar to those used by all genuine students of science.

And thus, finally, we are led to recognize three orders or degrees in science,—

The collection of data;
The correlation of cause and effect;
The philosophy of science.

Facts must be observed, data collected, objects preserved and compared. Many men of science do not proceed beyond this first stage; they are often amateur "naturalists" who observe and collect much that is of great value. This is alluded to as "spade work" in science. Some one has to do it. Linnaeus did it, Roy did it, Darwin and Wallace did it. All the Anatomists, Embryologists, Zoologists, Botanists, Entomologists, Conchologists, Geologists, and Meteorologists are men of this lowest or first order of science. Theirs are the descriptive sciences. Some persons to-day

hold that all science is nothing more than description, when it goes beyond that it ceases to be science and has become—I am not sure what they say it has become.

Now, once we begin to use the collected data to "explain" things, we are beyond merely descriptive science, beyond empirical science, we have entered on rational science, the science of the second order. When at last we begin to speak of the Philosophy of Biology, of Embryology, and so on, we have arrived at science of the third or highest order.

Few men of science can voluntarily long remain engaged in science of the first order. Instinctively they ask, what do these things mean, what is the bearing of all this? Luckily most of us have that curiosity that cannot be satisfied with merely surveying specimens on shelves in a museum or columns of figures in a Blue Book.

There is so much that seems in need of explanation. Some hold that explanation is no business of the man of science. I believe it is his chief business. The veriest layman cannot be restrained from making his guesses into the meaning of what he has seen or heard. The man of science, too, makes his conjectures, his hypotheses to account for so-and-so. If right, other facts will be explained and the working hypothesis become a rational theory of the phenomena; but if wrong, he sets about forming another explanation. Darwin did a great deal of this sort of thing; in fact the Darwinian theory is an all-embracing explanation or correlating of an enormous number of apparently unrelated observations. Similarly Dalton's great work in chemistry was essentially the deducing of laws of the widest application from carefully ascertained experimental data. But examples need not be multiplied; it is of the essence of all Natural Science, for facts or objects by themselves are of no interest, no utility; they lead to nothing.

Once the working hypothesis has passed into the realm

of an established theory, then scientific prediction, one of the most fascinating exercises for the human intellect, can be indulged in. In these investigations the man of science is above considerations of personal tastes, individual predilections or considerations of race. He is above considerations of race, for science is international, in spite of the childish assertion of our enemies that all true science has been, is, and must be German. The true man of science cannot be jealous that his brother has discovered something which he has missed, because he is too happy in the solace of the reflection that a new fact has been born into the common consciousness of mankind.

The highest science of all flourishes in a very rare atmosphere, one not to be lived in without due preliminary acclimatization. It is the realm of the Philosophy of Knowledge. Not merely what facts mean or even what generalizations can be framed upon them, but existence in itself, is what is studied here. This highest of all science examines everything that is fundamental in the constitution of things, and it includes the mind of man himself as one of the objects of the most careful study.

Science of the First order deals with Facts, Science of the Second order with Knowledge, Science of the Third order with Truth.

The Man of the third order of science—the reverent philosopher—aspires to a far more searching analysis, to a very much more comprehensive view of things than that which merely gives him natural law in the physical world. He is striving towards an ideal in knowledge, towards a form of wisdom which is the result of critical investigations in the realm of the most abstract forms of thought.

Science of the first order may measure the duration of a phenomenon in terms of seconds, science of the second order may attempt to explain why a phenomenon occupied the duration of seconds and not minutes or hours; but

science of the third degree asks, "What is time itself"? Is it a thing in itself or is it a Kantian category of the understanding, a conceptual relationship involving simultaneously the consciousness of the enduring ego along with the unconsciousness of the non-ego?

The man of the third degree of science asks what nexus, if any, is there between cause and effect; what is the relationship of antecedent to subsequent; what is matter, force, energy, yea, even what are time and space; what, in fact, are axioms, what are self-evident, truths, and so forth?

Science of the third degree may be called the Philosophy of Science, but not called Metaphysics, since that term denotes an intellectual outlook which is thoroughly obsolete. "Supra-material science" might be a less objectionable name. But when we call it "philosophy" we do not mean thereby something which thinks itself above all so-called empirical science, and which looks down on natural science as a gross thing belonging to a lower world.

The man of this highest science is merely the thinker passing from things to the relationships and meanings of things.

If "the undevout philosopher is mad," the unscientific philosopher is sterile; and better anything than intellectual sterility.

The goal of the highest science is the comprehension of the True and the Beautiful as only two different aspects of that supreme knowable, the intelligible cosmos.

Great is science and it will prevail. Let us not listen to people who tell us that science destroys poetry, the aesthetic sense, reverence or religion.

The day of the materialistic, unpoetical, unlovely, omniscient scientist is gone, we hope, for ever. The poetical man of science is certainly a possibility: he has come; and seen and conquered the absurd notion that the poetical outlook is incompatible with the scientific. "Proud philo-

sophy" and "cold science" belong to the eighteenth, not to the twentieth century.

The tints of the rainbow are not less but more beautiful to the physicist because he knows how they come to be there, and why in that particular order. Keats' lament that Newton, by explaining the rainbow, had taken the poetry out of it, means merely that Newton had taken the poetry out of the rainbow for Keats.

The lily-of-the-valley will smell quite as sweet to me even though I may live to see the day when its odor-producing substance has been identified, extracted, and named by the chemist. The man of science can be as sensitive as the veriest artist in presence of the beauty of coloring or of outline, even although he *is* able to explain the source or origin of them both.

The man of science is not the less sensitive to physical beauty which appeals to the senses because he happens also to know of another order of beauty which appeals to the intellect.

It is some time since true men of science jeered at religion. For, for some of them, what is called "religion" is one more mental phenomenon they are called upon to explain. The complete man of science is not only a poet, he is a reverent poet. The prayer of the lisping child, no less than the profoundest abstraction of the philosopher, is worthy of his study.

Why is life so vapid for so many? Because they know neither facts nor the explanations of facts. They know not the wonder, the beauty, the richness, or the variety of Nature's treasures. Culture is too often thought of as a state of mind which is the outcome of a knowledge of some of the expressions of Art; it is very rarely imagined as due to the possession of the scientific temperament. But culture is really not so much the result of the possession of knowledge,

as an attitude of mind or disposition, a sympathetic attitude of mind towards all mental products and intellectual interests.

The study of science is in many cases able to confer a truer culture than half a life-time spent in studios or around pianos. Your painter or musician *may* be a perfect barbarian, ignorant, superstitious, self-satisfied, and intolerant. There need be no fear of allowing science to be freely taught. Not science, but a hideous, perposterous, soul-destroying ethic it is, that has made the Germans what they are to-day. Science without a love of the beautiful, without respect for the past, without poetry, without sympathy, without reverence is the most repulsive product of the mind of man.

Such is the science of our enemies; and it has led them into the bottomless pit of national suicide. But such truly is science falsely so-called.

Science, the true, is the patient, loving interpretation of the world we live in; it is a striving to attain not merely to an understanding of the laws whereby the world is governed, but to the enjoyment of the beauty and order which is everywhere revealed. And the minds of men capable of attaining to such heights of appreciation, and the evidences around us of an all-prevading personality are only so many additional phenomena to be apprehended as constituent elements of that vast, sublime, age-enduring cosmos which we call the Universe.

After remarks by DR. BRONSON, DR. E. MACKAY, DR. A. H. MACKAY, and MR. PIERS, it was resolved that additional copies of the President's address be printed for early circulation.

The annual report of the Treasurer, MR. BOWMAN, was presented. It showed that the receipts for the year ending 30th September, 1916, were $364.70, the expenditures $129.30, and the balance in current account $235.40. The report having been audited, was received and adopted.

The librarian's report, dated 11th October, 1916, was presented by MR. PIERS, showing that 1,278 books and pamphlets had been received by the Institute through its exchange-list during the calendar year 1915; and 981 had been received during the first nine months of the present year (1916), namely January to September inclusive. The total number of books and pamphlets received by the Provincial Science Library (with which those of the Institute are incorporated) during the year 1915, was 1,731. The total number in the Science Library on 31st December, 1915, was 56,389. Of these, 40, 695 (about 72 per cent.) belong to the Institute, and 15,694 to the Science Library proper. 139 books were borrowed in 1915, besides those consulted in the Library. No binding or purchasing has been done by the Library directly.—The report was received and adopted.

On motion of MR. PIERS and DR. A. H. MACKAY, it was unanimously resolved that this society express its regret at the illness of MR. MAYNARD BOWMAN who is one of its oldest members, and its appreciation of his services as treasurer for the past nine years.

The following were elected officers for the ensuing year (1916-17):

President,—PROFESSOR DAVID FRASER HARRIS, M. B., C. M., M. D., B. SC. (LOND.), D. SC., F. R. S. E., F. R. S. C., *ex officio* F. R. M. S.

First Vice-President,—PRESIDENT ARTHUR STANLEY MACKENZIE, PH. D., F. R. S. C.

Second Vice-President,—PROFESSOR CLARENCE LEANDER MOORE, M. A., F. R. S. C.

Treasurer,—[GEORGE W. T. IRVING, appointed 12th Dec., 1916.]

Corresponding Secretary,—PROFESSOR EBENEZER MACKAY, PH. D.

Recording Secretary and Librarian,—HARRY PIERS.

Councillors without office,—ALEXANDER HOWARD MACKAY, LL. D., F. R. S. C.; PROFESSOR DONALD SUTHERLAND MCINTOSH, M. Sc.; CARLETON BELL NICKERSON, M. A.; PROFESSOR HOWARD LOGAN BRONSON, PH. D.; WILLIAM HARROP HATTIE, M. D.; PROFESSOR JOHN CAMERON, M. D., D. Sc., F. R. S. E.; and PROFESSOR ALBERT G. NICHOLLS, M. D., D. Sc., F. R. S. C.

Auditors,—GEORGE W. T. IRVING and DONALD M. FERGUSSON, F. S. C.

Owing to MR. BOWMAN'S illness it was decided to appoint a treasurer to succeed him, and it was resolved that the council nominate a suitable person for the office and report to the next ordinary meeting for approval.

FIRST ORDINARY MEETING.

Reading Room, N. S. Technical College, Halifax, N. S.; Monday, 13th November, 1916.

THE PRESIDENT, DR. D. FRASER HARRIS, in the chair.

The first ordinary meeting of the session was held on the conclusion of the Annual Business Meeting.

A paper entitled "A New Evening Primrose (*Œnothera novae-scotiae*)," by REGINALD RUGGLES GATES, PH. D., F. L. S., sometimg Lecturer in Biology and Cytology in the University of London, Eng., and just now of New York, was presented by DR. A. H. MACKAY. (See transactions, vol. XIV, pt. 2, p. 141. A vote of thanks was passed to DR. GATES for his communication.

SECOND ORDINARY MEETING.

Physiological Lecture Room, Dalhousie College, Carleton St., Halifax, N. S.; Tuesday, 12th December, 1916.

THE PRESIDENT, DR. D. FRASER HARRIS, in the chair.

It was reported that the council had, on 30th November, elected the following members:—ROBERT MATHESON, PH.

D., assistant professor of economic entomology, Cornell University, Ithaca, N. Y., U. S. A. (corresponding member); REGINALD RUGGLES GATES, PH. D., F. L. S., sometime lecturer in biology and cytology, University of London, Univ. of London Club, London, W. C., Eng., (corresponding member); and WILLIAM WEATHERSPOON WOODBURY, B. Sc., D. D. S., Spring Garden Road, Halifax, (ordinary member).

On motion of MR. PIERS and DR. A. H. MACKAY, GEORGE W. T. IRVING, of the Education Office, Halifax, was duly appointed Treasurer to succeed MR. BOWMAN who is ill.

A letter from MR. BOWMAN, dated 11th December, was read, thanking the society for its resolution of 13th November, and expressing appreciation of the courtesy received during the years he had acted as librarian and treasurer.

A paper entitled "A Comparative Study of the Piltdown, Cro-magnon, and Neanderthal Skull," was read by JOHN CAMERON, M. D., D. Sc., F. R. S. C., professor of anatomy, Dalhousie University, Halifax; the lecture being illustrated by lantern slides.

The subject was discussed at considerable length by the PRESIDENT, who presented a chemical note on the relation of men to monkeys; and also by PROF. MCINTOSH, DR. A. H. MACKAY, MR. IRVING, MR. PIERS, DR. BRONSON and PROF. C. J. CONNOLLY of Antigonish.

THIRD ORDINARY MEETING.

Physiological Lecture Room, Dalhousie College, Carleton St., Halifax, N. S.; Monday 12th March, 1917.

THE PRESIDENT, DR. D. FRASER HARRIS, in the chair.

PROF. E. MACKAY reported that a committee appointed by the council, and consisting of the PRESIDENT, DR. MACKENZIE and himself, had interviewed the Premier of the Province and urged that the grant to the Institute be continued, and furthermore requested that an adequate addition

be made to the grant in lieu of the grant which had been suffered to lapse in a past year. The Premier while recognizing the needs of the Institute and being in sympathy therewith, nevertheless felt that it would be very difficult to enlarge the grant as it appears in the estimates.

DR. A. H. MACKAY took the chair while DR. D FRASER HARRIS, read a paper on "The Physical Condition underlying the Varieties of Common Sensation." The subject was discussed by DR. A. H. MACKAY, DR. E. MACKAY, D. M. FERGUSSON, H. B. VICKERY and DR. A. G. NICHOLLS.

It was reported that on 5th January the council had elected as an ordinary member, CHARLES C. FORWARD of the Laboratory of the Inland Revenue Department, Halifax.

FOURTH ORDINARY MEETING.

Physiological Lecture Room, Dalhousie College, Carleton St., Halifax, N. S.; Monday 14th May, 1917.

THE PRESIDENT, DR. D: FRASER HARRIS, in the chair.

On motion of MR. PIERS and DR. A. H. MACKAY, the following resolution was unanimously adopted:—

The Nova Scotia Insitute of Science learns with deep regret of the death of its past president, HENRY SKEFFINGTON POOLE, D. Sc., Assoc. R. S. M., F. G. S., F. R. S. C., which occurred at his residence, "Spreyton," Guildford, Surrey, England, on the 31st of March, 1917, at the age of seventy-two years. Dr. Poole who was the only son of a foundation member, joined the Institute on 11th November, 1872, when Inspector of Mines, and was one of its oldest active members. He occupied with dignity the presidential chair from November, 1902, to October, 1905. He was an able geologist and mining engineer, devoted special attention to the coal-measures of Nova Scotia, on which he was an acknowledged authority, and his writings have added much to our knowledge on this subject. All who came into personal contact with him bear witness to his fine qualities as a man.

The Institute of Science also desires to place on record its sense of the loss which it and the cause of education have sustained through the death of its former president, ALEXANDER McKAY, M. A., late supervisor of public schools, Halifax, which took place at Dartmouth, N. S., on 8th April, 1917, at the age of seventy-five years. Mr. McKay joined the society on 5th February, 1872, and was its oldest active member. He was recording-secretary from 1886 to 1894, and president from November, 1897, to November, 1899. While not actually engaged in scientific research himself, he always took keen interest in all work related to science in this province. His name will be long remembered for his great service in the cause of education.

HUBERT BRADFORD VICKERY, B. Sc., science master, Bloomfield High School, Halifax, read a paper on "The Isochlors of Western Nova Scotia." The subject was discussed by DR. A. H. MACKAY, DR. H. D. BRUNT, H. PIERS, D. M. FERGUSSON, PROF. L. C. HARLOW (Truro), PROF. E. MACKAY, and PROF. D. S. MCINTOSH.

The following papers were read by title:—

(1) "Phenological Observations, Nova Scotia, for 1916."—by A. H. MACKAY, LL. D., F. R. S. C., superintendent of education, Halifax. (See Transactions, p. 147).

(2) "Notes on the Birds of the Grand Pre Region, Kings Co., Nova Scotia."—By ROBIE W. TUFTS, Wolfville, N. S. (See Transactions, p. 155).

(3) "The Orthoptera (Cockroaches, Locusts, Grasshoppers and Crickets) of Nova Scotia; with descriptions of the species and notes on their occurrence and habits."—By HARRY PIERS, curator of the Provincial Museum of N. S., Halifax. (See Transactions, p. 201).

A vote of thanks was passed to MR. TUFTS (non-member) for his paper.

HARRY PIERS,
Recording Secretary.